INTRODUCTION TO ORGANIC CHEMISTRY

IB Chemistry

Topic 10 – Organic

Modified From:

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Orgins

- Originally defined as the chemistry of living materials or originating from living sources
- Wohler synthesized urea from non organic sources
- Now generally defined as the chemistry of carbon and its compounds

Carbon Characteristics

- Electron configuration $1s^2\ 2s^2\ 2p^2$
- Four valence electrons
- Hybridization
- Forms four bonds with other atoms including other carbon atoms
- Able to catenate – form chains and rings
- Able to form multiple bonds

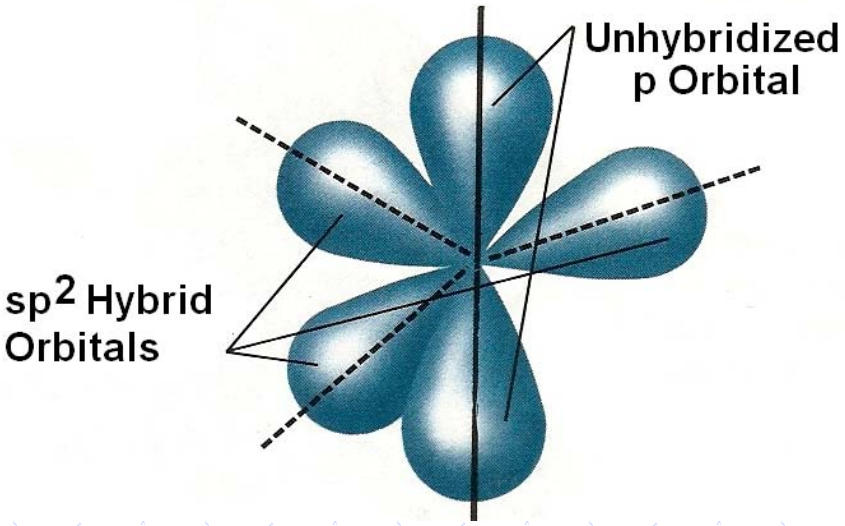
Carbon is Unique

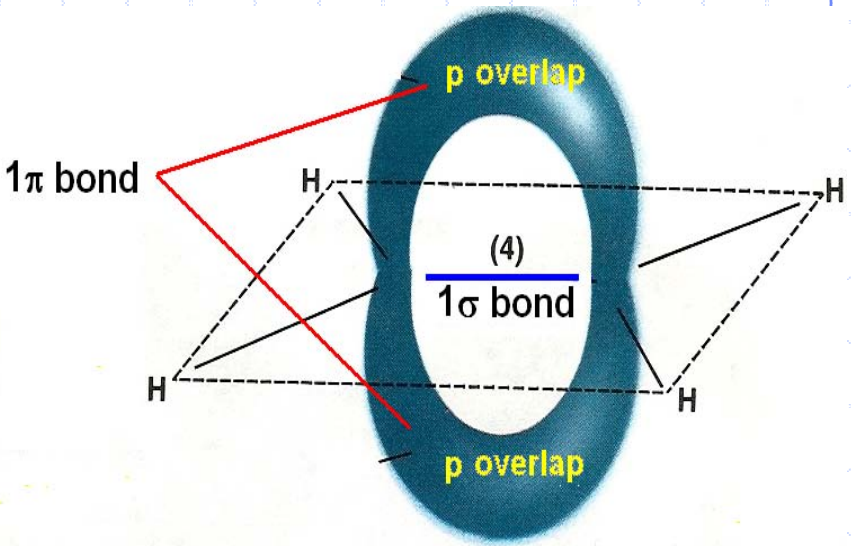
- More than 90% of all known compounds are carbon compounds and therefore organic
- Living systems are all carbon based
- Carbon has unique characteristics that make multiple compounds possible

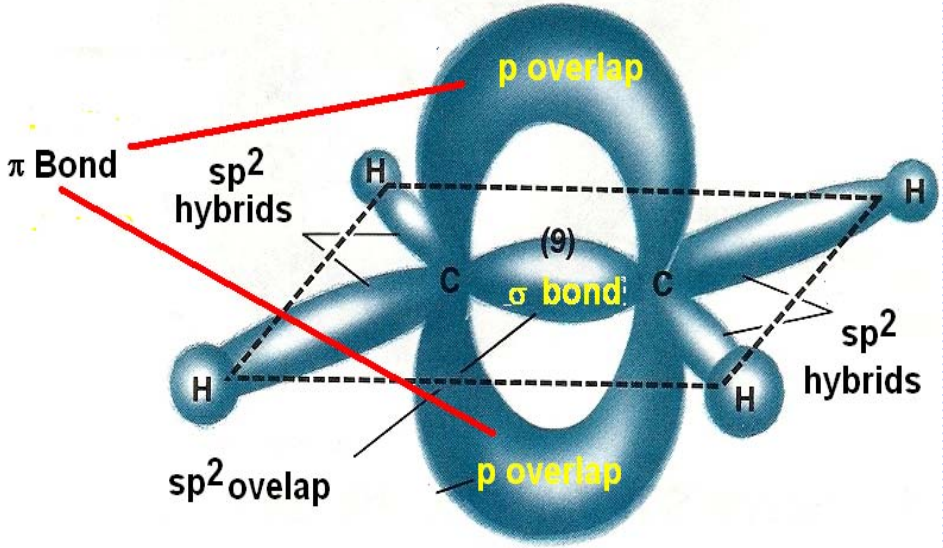
Unique Characteristics of Carbon

- Can form multiple bonds to itself and others
- Strength of C-C bond is large compared to that of other like atom-atom bonds.
- Carbon can form chains and rings
- Carbon cannot expand it's octet of valence electrons.

Bonding in ethene





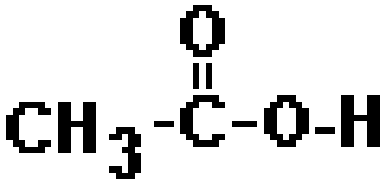


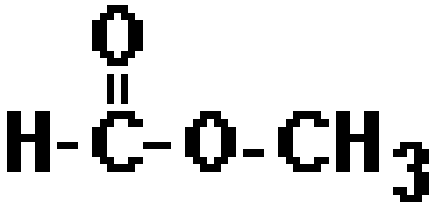
Classifying Organic Compounds

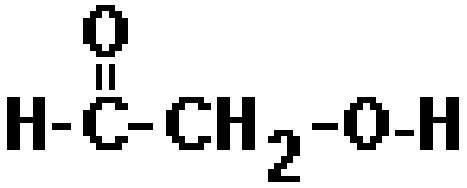
- Many configurations of carbon atoms are possible in a molecule
- Empirical and molecular formulas are the same for many different compounds
- The relative locations of various combinations of atoms in a formula is very important
- Structural formulas show the location and bonding pattern for each atom in a formula

Structural Formulas

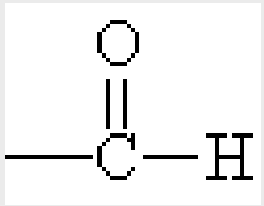
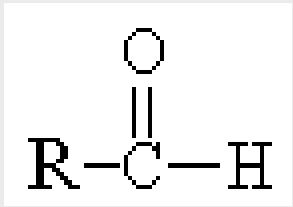
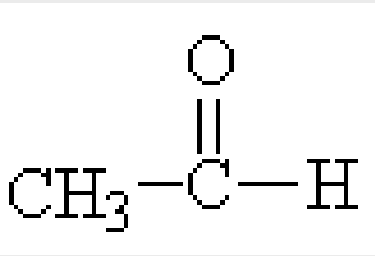
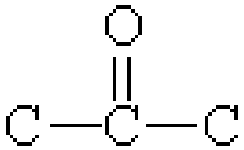
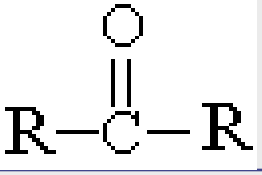
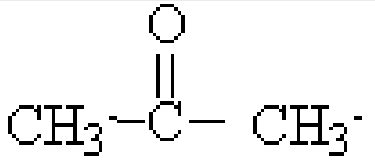
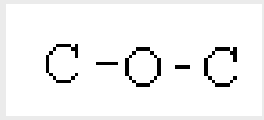
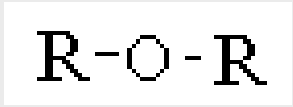
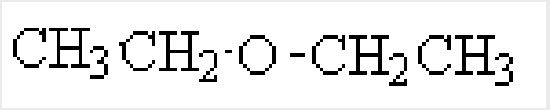
- The three molecules below both have the same empirical and molecular formulas but they have very different characteristics. They are considered different compounds.



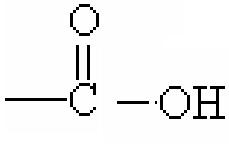
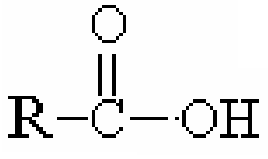
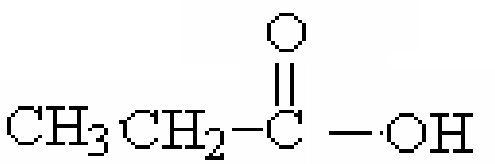
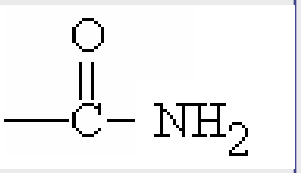
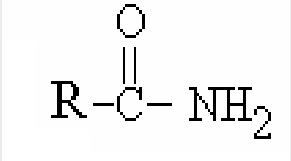
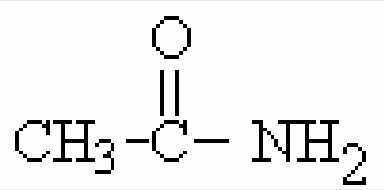
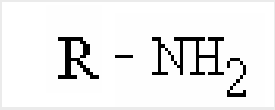
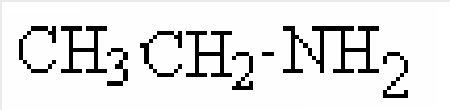
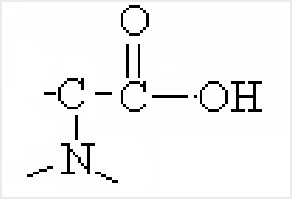
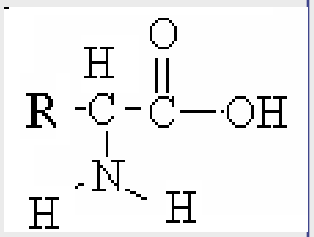
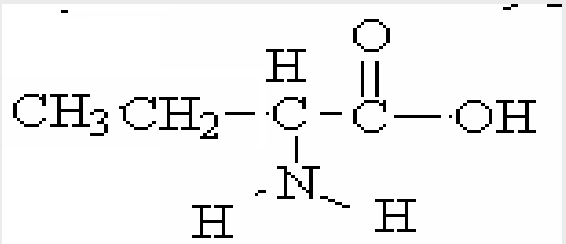




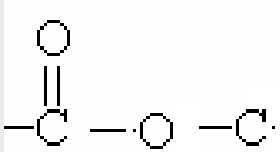
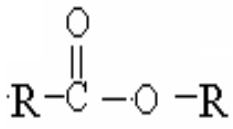
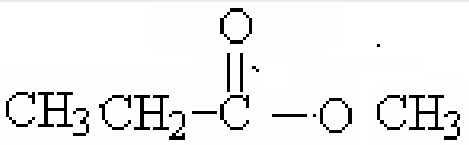
Functional Groups

	—OH	R- OH	CH_3-CH_2-OH
			
			
			

Functional Groups

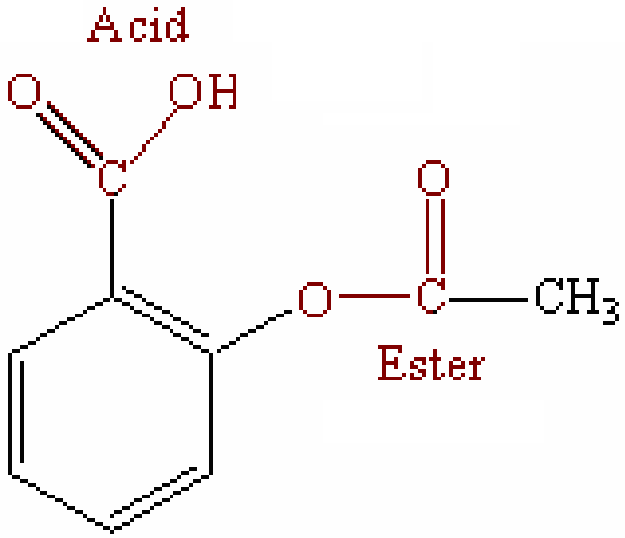
Carboxylic Acid			
Amide			
Amine			
Amino acid			

Functional Groups

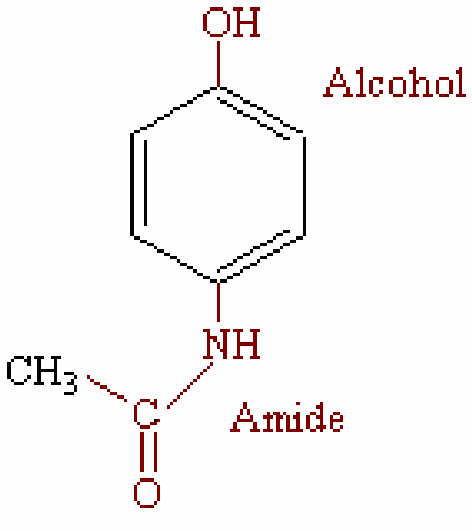
Ester			
Thiol	-S-H	R- SH	CH_3CH_2-SH

Functional Groups

- Many larger molecules have more than one functional group.



Acetylsalicyclic acid
Aspirin



Acetoaminophen
(Tylenol)

Functional Groups

- The physical and chemical properties of organic compounds are related to their functional groups.
- Compounds may have different numbers of carbon atoms but the same functional group(s) will often have similar properties.

Homologous Series

- Compounds that have the same general formula but differing lengths of carbon chains form a homologous series

Homologous Series: Ex 1

CH_4	Methane
C_2H_6	Ethane
C_3H_8	Propane
C_4H_{10}	Butane
C_5H_{12}	Pentane

A homologous series of alkanes

Homologous Series: Ex 2

C_2H_4	**Ethene**
C_3H_6	**Propene**
C_4H_8	**1-Butene**
C_5H_{10}	**1-Pentene**

A homologous series of alkenes

Homologous Series: Ex 3

CH_4	**Methanol**
C_2H_6	**Ethanol**
C_3H_8	**1-Propanol**
C_4H_{10}	**1-Butanol**
C_5H_{12}	**1-Pentanol**

A homologous series of alcohols

Hydrocarbons

- Hydrocarbons are organic compounds that are made up of only carbon and hydrogen.
- There are several different categories of hydrocarbons including:
  - Alkanes
  - Alkenes
  - Alkynes
  - Cyclic Hydrocarbons
  - Aromatic hydrocarbons

Alkanes

- Alkanes are hydrocarbons that have only C-C single bonds.
- Examples
  - Methane CH_4
  - Ethane CH_3-CH_3
  - Propane CH_3-CH_2-CH_3
  - Butane CH_3-CH_2-CH_2-CH_3
  - Pentane CH_3-CH_2-CH_2-CH_2-CH_3